IJMA

International Journal of Medical Arts

VOLUME 6, ISSUE 5, MAY 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [General Surgery]

Original Article

Comparative Study between Open and Laparoscopic Varicocelectomy in Bilateral Varicocele

Ahmed Hamoda Ahmed Awad-Allah [*1], Mohamed Mustafa Balbola [1], Mohamed Mohamed Shahin [2], Magdi Elghannam [3], Mostafa M. Shakweer [4]

[1] Department of General Surgery, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt
[2] Department of Pediatric Surgery, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt
[3] Department of Clinical Pathology, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt
[4] Department of Radiodiagnosis, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt

Article information

Received: 14-12-2022

Accepted: 16-07-2023

DOI: 10.21608/IJMA.2023.180812.1571.

*Corresponding author
Email: ahmedhamoda1988@gmail.com

Citation: Awad-Allah AHA, Balbola MM, Shahin MM, Elghannam M, Shakweer MM. Comparative Study between Open and Laparoscopic Varicocelectomy in Bilateral Varicocele. IJMA 2024 May; 6 [5]: 4452-4459. doi: 10.21608/IJMA.2023.180812.1571.

ABSTRACT

Background: Varicoceles are tortuous, abnormally dilated scrotal veins. Although there are variations in recurrence rates, none of the surgical techniques outlined for varicocelectomy have been shown to be superior to the others in their ability to increase fertility.

Aim of the work: Comparison between open and laparoscopic varicocelectomy in bilateral varicocele regarding outcome and complications.

Patients and Methods: One-hundred patients with bilateral primary varicocele and sperm count below 20 million/c.c., were randomly allocated into either open surgical varicocelectomy via sub inguinal approach, or laparoscopic varicocelectomy. For each patient, operative time, recovery rate and complications were reported. Semen analysis, serum sex hormones [Testosterone, FSH and LH] levels were analyzed preoperatively, 3 and 6 months after surgery.

Results: In the laparoscopic group, there was statistically significant lower operative time than the open group [22±8.6 vs. 28±6.2; P=0.03]. Also, the laparoscopic group had significant lower hospital stay [P=0.01] and rapid return to normal activity [P=0.01] than the open group. Regarding complications, four patients in the laparoscopic group developed pneumo-scrotum versus none in the open group [P=0.01]; otherwise, the overall complication rate was higher in the open group [P=0.04]. Sperm count and motility were improved in both groups after 3 and 6 months; however, abnormal forms of sperms were improved only in the laparoscopic group [P=0.05].

Conclusion: Laparoscopic varicocelectomy was associated with shorter operative time, hospital stay, and rapid return to normal activity. Furthermore, overall complication rate was less with laparoscopic varicocelectomy except for pneumo-scrotum, which was more frequent with laparoscopic varicocelectomy.

Keywords: Varicocele; Varicocelectomy; Laparoscope; Semen analysis.

INTRODUCTION

Around 5 to 20% of men in the general male population have varicoceles, which are scrotal veins that are abnormally dilated and twisted [1]. However, this percentage is higher, approximately 40%, in men who experience infertility [2]. To diagnose male infertility, a thorough medical and reproductive history, physical examination and semen analysis should be conducted on the patient [3].

It is assumed that the varicocele will affect testicular functioning. According to the etiology, cytotoxic metabolite reflux, an elevation in scrotal heat, and hypoxia in the testicular tissue are all factors [4]. The varicocele appears to have progressive negative consequences on spermatogenesis. Varicoceles linked to secondary infertility suggest they impair spermatogenesis more than in general population [5].

Managing varicoceles for male factor infertility is complex due to ongoing debate on causation and treatment options. Surgery is suggested for adults with abnormal semen analysis [6].

Varicoceles can be treated surgically or via embolization. Various surgical techniques exist, but none have shown superior efficacy in improving fertility, with differing recurrence rates reported [7].

Every surgical technique for treating varicoceles involves tying off and cutting the spermatic veins [pampiniform plexus] in the spermatic cord, which causes the vasal veins to take over and drain the testis instead [8]. Possible complications resulting from surgical treatment of varicoceles are rare and typically mild. In general, complications may arise in 1% to 5% of cases, depending on the specific surgical approach employed [9].

Compared to low inguinal or sub-inguinal procedures, which have a relapse rate of 1% to 2%, high ligation approaches such as retro-peritoneal or laparoscopic procedures have a higher relapse rate of up to 15%. As a result, these high ligation approaches are considered less than ideal compared to the lower approaches [10].

Laparoscopic varicocelectomy is a surgical technique to treat varicoceles by cutting spermatic veins above the internal ring in the retroperitoneal space. Its popularity has grown due to clearer visualization with magnification, reducing varicocele recurrence risk and protecting testis from ischemic damage. Preservation of lymphatics and genito-femoral nerve branches may lower the risk of lymphocele and postoperative discomfort, enhancing patient outcomes [11, 12].

Although there is some evidence of the benefits of a microsurgical technique, the existing literature does not clearly demonstrate that any surgical procedure is preferable [13].

The current study aims at comparing between open and laparoscopic Varicocelectomy in bilateral varicocele regarding various fertility and operative details.

PATIENTS AND METHODS

The present study involved 100 patients with bilateral primary varicocele. Patients were admitted to Al-Azhar University Hospital, New Damietta in General Surgery Department during the period from July 2019 to July 2022. All patients included in this study have sperm count below 20 million/ c.c. [oligospermia] and or asthenozoospermia; thus, all patients were indicated for surgery according to European Association of Urology guidelines [6].

All patients were evaluated for the presence of secondary varicocele through detailed history and physical examination. Patients were asked about the primary complaint and type of infertility [primary or secondary]. Patients were examined for abdominal masses to exclude secondary varicocele, and examination for degree and laterality of varicocele.

Pre-operative assessment

Routine preoperative laboratory investigations were conducted for all patients. Semen analysis and serum sex hormones [Testosterone, FSH and LH levels] were also analyzed. In addition, each patient was subjected to pelvi-abdominal ultrasound, to detect any abdominal mass that may cause secondary varicocele, and scrotal color Duplex studies to assess the degree of varicocele.

A close collaboration was established with the andrology section of our institution to facilitate enhanced preoperative patient selection and investigations. A comprehensive preoperative assessment was conducted to ascertain the most suitable candidates for each surgical approach based on individualized considerations. Additionally, post-operative fertility status follow-up was diligently performed in consultation with the andrology specialists.

Patients were randomly allocated into two equal groups; each group includes 50 patients;

group [A], surgery was applied through open sub inguinal approach was, and group [B], laparoscopic varicocelectomy was done.

All patients that underwent open surgical or laparoscopic varicocelectomy had been done bilaterally. All patients sign on informed consent about technique.

Group A [sub-inguinal Approach]

During the surgery, the patient was placed in a supine position under general or spinal anesthesia. A short transverse incision was made about 2.5 cm below the external ring. Camper's fascia and Scarpa's fascia were divided, and if the superficial epigastric artery and vein were encountered, they were retracted or clamped, divided, and ligated [or clipped]. The surgeon inserted an index finger into the wound and along the cord into the scrotum, hooking it under the external inguinal ring and retracting it upward. A small Richardson retractor was then slid along the back of the index finger and retracted downward over the cord toward the scrotum. The assistant then grasped the cord with a Babcock clamp and delivered it through the wound. A large Penrose drain was placed around the cord to expose it, and the posterior cremasteric vessels were clamped with hemostatic clips and ligated. The dilated veins within the spermatic cord were then isolated in groups and identified carefully before being clamped and ligated. The surgeon took care to ensure that the spermatic artery was not included in the ligation procedure. Lidocaine was dropped early on the cord to vasodilate the artery and protect it from spasm.

The surgeon identified and ligated the vasal veins along with the varicocele. After the procedure, the wound is closed using standard techniques. By performing the surgery in this way, the testicular artery supply is preserved and the lymphatic drainage of the testis is conserved.

Group B [Laparoscopic Varicocelectomy]

The patient was given general anesthesia and positioned in a modified Trendelenburg position, which tilted the body 15 degrees to move the bowels away from the pelvis. The skin was then cleaned, and a Betadine antiseptic solution was applied from the xiphisternum [the bottom of the sternum] down to the mid-thigh and bilaterally to the back of the armpits.

The surgery began with a small 1 cm incision made below the belly button in the middle of the abdomen, down to the fascia. The skin was then clipped with towel clips at the edges of the incision and pulled away from the intraperitoneal contents. Next, a veress needle was inserted through the incision into the peritoneum and directed towards the pelvis. A small amount of sterile saline was dripped into the needle to confirm its proper placement, and then positive flow carbon dioxide was connected to the needle to distend the cavity with gas at a pressure of 12 to 15 mmHg. Once the pneumoperitoneum was achieved, the needle was removed, and a 10 mm laparoscopic trocar was inserted through the same site. A 10 mm laparoscope was then inserted into the sheath, and two additional working ports [5 mm and 10 mm] were inserted in the lower quadrants, at the lateral edge of the rectus muscle, to provide access for operating instruments. The patient was then rotated, with the side to be operated upon elevated, to displace the intraperitoneal contents away from the operative field.

A lateral incision was made in the peritoneum next to the testicular vessels. The vascular pedicle was then dissected using a combination of sharp and blunt techniques. Once it was isolated, the pedicle was doubly clipped both proximally and distally, usually within 1 to 2 cm of the internal ring, and then divided using scissors. Hemostasis was achieved, and the carbon dioxide gas was expelled from the peritoneal cavity. Finally, all trocars were removed, and the incisions were closed using 3/0 simple, interrupted, prolene sutures.

Statistical analysis

The outcome measures were coded, entered, and analyzed using Microsoft Excel software. After this, the data was imported into the Statistical Package for the Social Sciences [SPSS version 20.0] software for further analysis. Descriptive statistics such as means, standard deviations, frequencies, and percentages were utilized to summarize the characteristics of the study population. The comparison of outcomes between the two surgical techniques was performed using independent t-tests or non-parametric equivalents for continuous variables and chi-square tests for categorical variables. Continuous consecutive variables are compared using either paired t-test [for 2 samples] or the ANOVA test [for multiple samples]. A p-value of less than 0.05 was considered statistically significant.

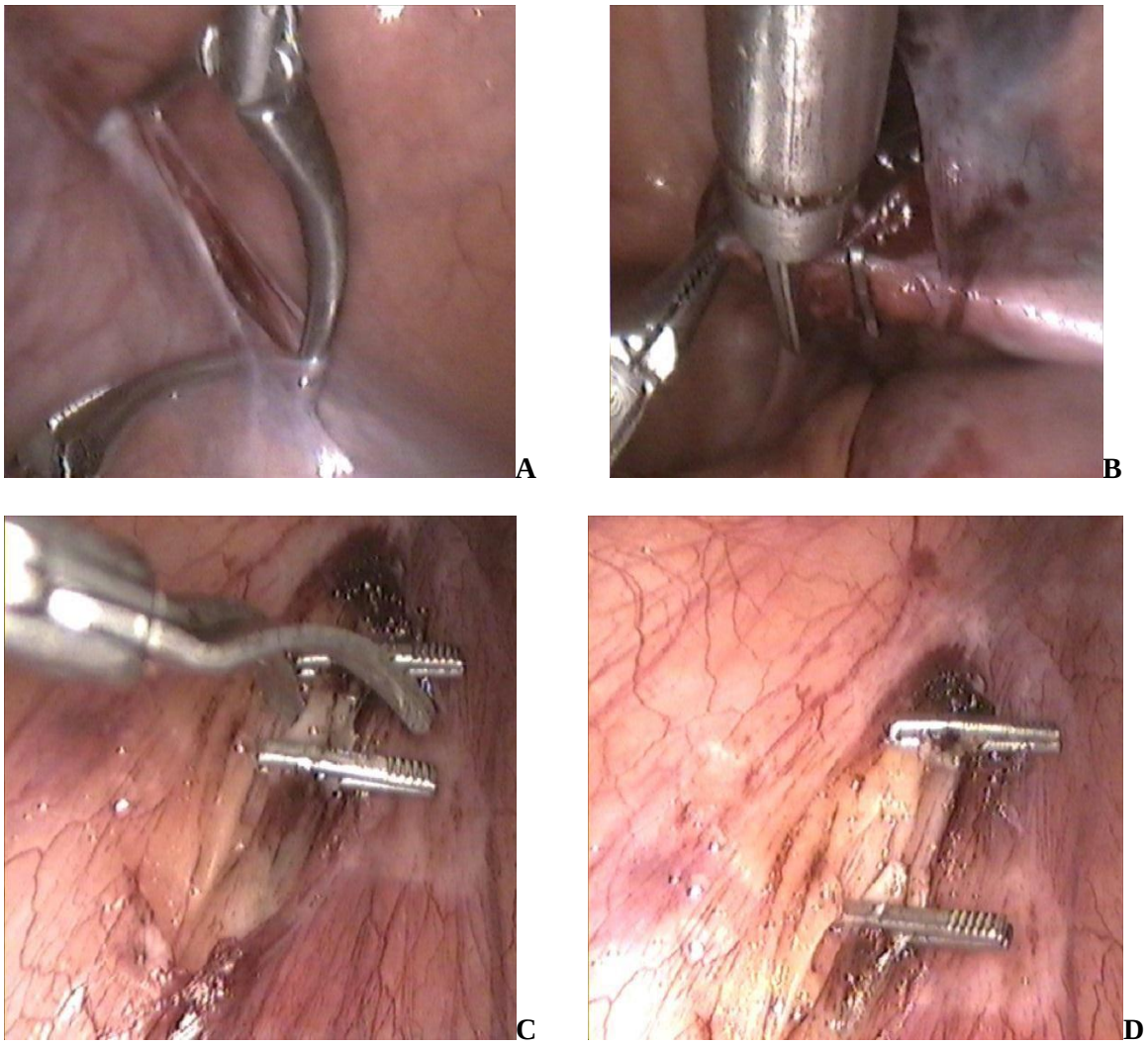

Figure [1]: Laparoscopic varicocelectomy; A: Dissection of the spermatic vessels; B: Clipping of the spermatic vessels; C: Division of the spermatic vessels; D: Spermatic vessels after division

RESULTS

No significant difference was indicated between both groups regarding in terms of age, preoperative semen analysis and grading of varicoceles. Laparoscopic group showed significant decrease of operative time [28 ± 6.2 vs. 22 ± 8.6 min; P = 0.03], hospital stay [30 ± 4.9 vs. 20 ± 2.7 h; P=0.01] and return to normal activity [11 ± 1.6 vs. 6 ± 1.9 days; P = 0.01] as shown in Table [1].

Regarding complications, four patients in the Laparoscopic group developed pneumo-scrotum versus none in the open group [P=0.01]. Otherwise, the overall complication rate was significantly higher in the open group [P=0.04] as shown in Table [2].

There was no significant difference between both groups regarding all parameters of semen analysis at three and six months after surgery [Table 3].

After the surgery, an analysis of the patient's semen was conducted, which revealed a significant improvement in sperm count and motility at three- and six-months post-operation. Moreover, the analysis showed that the percentage of abnormal forms had improved in the laparoscopic group, but not in the open group [Table 4].

There was no significant difference between both groups regarding serum sex hormones before surgery and at three- and six-month's postoperative [Table 5].

After surgery, 30% in open and 10% in the laparoscopic groups had residual reflux [P = 0.01]. Laparoscopic group had higher pregnancy rates [albeit nonsignificant] and greater testicular volume increase [also nonsignificant] compared to the open group [Table 6].

Table [1]: Comparison of preoperative and operative outcomes between the study groups

			Open group	Laparoscopic group	P value
Age	Mean ± SD		29.5 ± 6.3	31.4 ± 3.9	0.4
Pre-operative semen analysis	Sperm count		9.2 ± 2.4	8.7 ± 3.1	0.72
	Motility %		28 ± 6.7	29 ± 7.3	0.69
	Abnormal form%		42 ± 11.7	41 ± 12.4	0.83
	Semen volume in ml		2.8 ± 0.6	2.6 ± 0.7	0.09
	Liquefaction time in min		17 ± 5.6	16 ± 4.7	0.47
Grading	I	Right	23 [69.7%]	25 [71.4%]	0.7
		Left	-	-	
	II	Right	7 [21.2%]	6 [14.2%]	
		Left	13 [39.4%]	16 [45.7%]	
	III	Right	3 [9.1%]	4 [11.4%]	
		Left	20 [60.6%]	19 [54.3%]	
Operative time [Min.]			28 ± 6.2	22 ± 8.6	**0.03***
Hospital Stay [h]			30 ± 4.9	20 ± 2.7	**0.01***
Return to normal activity [days]			11 ± 1.6	6 ± 1.9	**0.01***

Table [2]: Comparison of post-operative complications between studied group

	Open group	Laparoscopic group	P value
Shoulder tip pain	-	-	-
Pneumoscrotum	-	4 [8%]	**0.01***
Wound infection	3 [6%]	-	**0.05***
Recurrence	6 [12%]	-	**0.01***
Hydrocele	6 [12%]	3 [6%]	0.2
Testicular atrophy	-	-	-
Total	15 [30]	7 [14]	**0.04***

Table [3]: Comparison of Post-operative semen after 3 and 6 Months between studied groups

	After 3 Months			After 6 Months		
	Open group	**Laparoscopic group**	**P value**	**Open group**	**Laparoscopic group**	**P value**
Sperm count	13± 4.3	14.5± 3.9	0.3	17.5± 5.3	18± 4.2	0.7
Motility%	36± 8.3	37± 9.8	0.7	39± 11.2	40± 12.3	0.8
Abnormal form%	41± 9.4	38± 12.3	0.3	38± 8.1	36± 9.7	0.3
Semen volume [ml]	2.8± 0.6	2.6± 0.9	0.1	3± 0.9	2.9± 0.9	0.6
Liquefaction time [min]	18± 3.9	17± 4.7	0.5	15± 2.4	13± 7.3	0.17

Table [4]: Comparison of studied groups regarding follow-up of semen analysis

	Open group				Laparoscopic group			
	Pre-operative	**3 months**	**6 months**	**P value**	**Pre-operative**	**3 months**	**6 months**	**P value**
Sperm count	9.2 ± 2.4	13 ± 4.3	17.5 ± 5.3	**0.04***	8.7 ± 3.1	14.5 ± 3.9	18 ± 4.2	**0.01***
Motility%	28 ± 6.7	36 ± 8.3	39 ± 11.2	**0.01***	29 ± 7.3	37 ± 9.8	40 ± 12.3	**0.01***
Abnormal form%	42 ± 11.7	41 ± 9.4	38 ± 8.1	0.7	41 ± 12.4	38 ± 12.3	36 ± 9.7	**0.05***
Semen volume [ml]	2.8 ± 0.6	2.8 ± 0.6	3 ± 0.9	0.51	2.6 ± 0.7	2.6 ± 0.9	2.9 ± 0.9	0.88
Liquefaction time [min]	17 ± 5.6	18 ± 3.9	15 ± 2.4	0.37	16 ± 4.7	17 ± 4.7	13 ± 7.3	0.46

Table [5]: Comparison of hormonal change between studied groups

		Open	Laparoscopic	P value
FSH [mlU/ml]	pre-operative	6.5± 2.6	6.6± 2.7	0.18
	3 months post	6.3± 2.5	6.4± 2.5	0.65
	6 months post	6.1± 2.6	6.3± 2.3	0.24
LH [mlU/ml]	pre-operative	6.1± 2.2	5.7± 2.9	0.12
	3 months post	5.9± 2.8	5.4± 2.7	0.13
	6 months post	5.7± 2.5	5.3± 2.6	0.09
Testosterone [ng/ml]	pre-operative	4.6± 1.9	4.9± 1.4	0.13
	3 months post	4.9± 1.4	5.2± 1.1	0.26
	6 months post	5.1± 1.2	5.3± 1.1	0.1

Table [6]: Comparison of post-operative outcomes between both groups

		Open [n=50]	Laparoscopic	P value
Spermatic vein reflux	Present Absent	15 [30] 35 [70]	5 [10] 45 [90]	**0.01***
Rate of pregnancy		8 [16%]	10 [20%]	0.23
Testicular volume	Pre-Operative Post-operative	14.5 [0.51] 15.07 [0.58]	14.6 [0.62] 15.2 [0.60]	0.34 0.41

DISCUSSION

In our study, the preoperative semen analysis of all patients was subnormal, as the mean sperm count of all patients was [9.2 - 8.7] million/ml, the mean motility was [28-29%] and their mean percentage of abnormal forms was [42-41%] for open and laparoscopic groups respectively.

Varicocele is a condition that can disrupt the process of sperm production. This can result in abnormal semen quality, characterized by a low sperm count, reduced sperm motility, and a high percentage of abnormal sperm forms [14].

In this study, the operative time of laparoscopic varicocelectomy was shorter than open one [22 minutes versus 28 minutes]. Furthermore, most of the laparoscopic group patients were discharged in the same day of surgery after full recovery from anesthesia and the rest were discharged in the morning of the second day.

Similarly, the hospital stay of most of other works was about 24 hours or by others, within the first day. In general, most authors stated that hospital stay as well as return to normal activity in laparoscopic varicocelectomy was shorter compared to open procedure. Unlike our finding, **Bebars *et al.*** [15] reported that the average time for the open procedure was 69.5 minutes, while for laparoscopic varicocelectomy, it was 74.2 minutes. This difference in time may be due to the laparoscopic technique being a relatively new approach to treating varicocele, and also because it can be influenced by the surgeon's experience. Additionally, patients who underwent the open procedure stayed in the hospital for 2 to 8 days, with an average of 3.5 days. In contrast, patients who had the laparoscopic procedure stayed for a shorter period of time, between 1 and 3 days, with an average of 1.3 days.

Sifontes *et al.* [16] indicated that the surgical time was significantly shorter in laparoscopic group with an average of 17.1 minutes, and for the return to usual activities [2.8 vs 4.4 days]. In the study of **Jeelani *et al.*** [17], on average, the laparoscopic varicocelectomy procedure took 48 minutes, while the open surgery took 57 minutes. Patients who underwent the laparoscopic procedure had an average hospital stay of 35.6 hours, while those who had the open surgery stayed for an average of 50.6 hours.

Mbouché *et al.* [18] conducted a retrospective review of patient records from three health centers in Yaoundé who had undergone laparoscopic varicocelectomy. The study found that the average operative time was 31.9 ± 8.6 minutes, with a range of 16 to 60 minutes. Additionally, all patients were discharged on the first day after the surgery.

Hydrocele is a common complication after varicocelectomy and has been reported to have a rate of up to 39% [19]. Hydrocele is caused by lymphatic drainage impairment which mostly occurred in cases of en-block ligation of the veins than that occurred with individual vein ligation. With laparoscopy, some authors revealed no cases of hydrocele [20].

The most frequent complication following varicocelectomy is recurrence. The main reason for recurrence is the presence of persistent or overlooked small collateral veins during the ligation procedure [21].

There were some complications encountered in laparoscopic group which was related to laparoscopy itself and, of course, these complications were not present in open group. These complications were in the form of pneumoscrotum in 8% of patients disappeared conservatively within the first day. Also, in our study, open surgery group showed 3 [6%] cases of wound infections, 6 [12%] cases of hydrocele and recurrence. While in laparoscopic group only 3 [6%] cases of hydrocele. There were no significant complications during the surgery. None of the patients experienced issues such as testicular atrophy, damage to the genitofemoral nerve, or the development of an incisional hernia.

In another study by **Hassan *et al.*** [22], the incidence of hydrocele in laparoscopic group was 5% and in open high ligation was 12%. While reported that 5.3% of patient showed hydrocele after laparoscopic varicocelectomy.

In this study, similar to other works, hydrocele occurred in 6% of patients in laparoscopic group opposite 12% of patients in open group.

Borruto *et al.* [23] conducted a Meta-analysis on 1340 patients, globally recurrence rate of 4.7% there was no statistical difference between the 2 groups.

The incidence of hydrocele after surgery was 9.5% ± 7.1% for laparoscopic group and 6.7% ± 6.7% for open surgery [not significant]. In addition, the study found that patients who underwent dye injection before laparoscopic ligation to identify lymphatics had a lower rate of postoperative hydrocele. **Mohammed *et al.*** [24] reported that there was no significant difference between LS and OS as per the postoperative hydrocele.

In this study, preoperative spermatic vein reflux was detected in all patients with clinical varicocele. All patients with clinical recurrence showed residual reflux over the spermatic cord. The laparoscopic group [10 [20%]] exhibited a higher pregnancy rate than the open group [8 [16%]] without statistical significance [p = 0.23].

Diegidio *et al.* [25] analyzed data from 33 studies involving 5000 male patients with infertility and reported similar results. The overall pregnancy rate was 38.37%, with the highest rates seen in the group undergoing microsurgical sub-inguinal and microsurgical inguinal operations [44.75% and 41.78%, respectively]. Other surgical methods demonstrated lower pregnancy rates compared to microsurgical varicocelectomy. For instance, the pregnancy rates were 27.5% for laparoscopic technique, 30.1% for conventional inguinal surgery, and 34.2% for the Palomo surgical technique.

Baazeem *et al.* [26] conducted a meta-analysis consisting only of randomized controlled trials [RCTs], and their findings supported those of previous studies. Their analysis showed that varicocelectomy was linked with a significant increase in sperm concentration, as well as improvements in total and progressive motility.

Following the varicocelectomy procedure, there was a statistically significant increase in the mean total sperm count and the percentage of motile sperm at both the three-month and six-month postoperative marks compared to the levels prior to the surgery. **Phan *et al.*** [27] reported that the first instance of a spontaneous pregnancy in a couple was reported two months after the surgery. Overall, 26.7% [23 out of 86] of all couples had achieved a pregnancy by the end of the follow-up period.

In the present study, there were hormonal improvement over time in both groups, but there was no statistically significant hormonal change between studied group. Likewise, **Almahdy *et al.*** [28] showed no statistically significant change in the level of FSH and LH, and testosterone postoperative. However, testosterone level showed a significant increase in patients with preoperative low testosterone level [≥ 3 ng/ml].

In another study, **Hsiao *et al.*** [29] found that serum testosterone levels significantly improved after varicocelectomy with a mean follow-up period of 7 months. All patients included in the study had a preoperative serum testosterone level of less than 4 ng/ml. Based on these findings, it can be inferred that varicocele repair can be effective in increasing serum testosterone levels in patients with varicocele and low testosterone.

It is crucial to acknowledge several limitations that could have influenced the results and of our findings. Firstly, the absence of inclusion of alternative techniques such as angioembolization and microsurgery in our study poses a limitation, as these approaches may offer distinct advantages that were not explored in our research. Also, the relatively small sample size and single-center nature of our study may limit the generalizability of our results to a broader population. Furthermore, the lack of long-term follow-up data beyond six months restricts our ability to fully assess the sustained efficacy and potential complications associated with each surgical approach.

Conclusion: A quicker return to normal activity and a shorter hospital stay were all benefits of laparoscopic varicocelectomy. Laparoscopic varicocelectomy also had a lower overall complication rate, with the exception of pneumo-scrotum.

Conflict of Interest: None.

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IJMA

International Journal of Medical Arts

VOLUME 6, ISSUE 5, MAY 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780